CONTROL METHOD OF SUSCEPTIBLE INRUSH CURRENTS PASSING THROUGH A LOAD SWITCH, AND CORRESPONDING ELECTRONIC CIRCUIT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of U.S. application Ser. No. 16/026,503, filed on Jul. 3, 2018, which claims priority to French Patent Application No. 1756995, filed on Jul. 24, 2017, which applications are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] Embodiments of the invention relate to a control method of susceptible inrush currents passing through a load switch, and a corresponding electronic circuit.

BACKGROUND

[0003] In a general manner, a conventional charge switch often comprises a metal oxide semiconductor (MOS) switching transistor of P-type having a low threshold voltage. To obtain a lower resistance in the "on" state of the transistor, the rating of this MOS transistor of P-type is generally bigger relative to other transistors in the same electronic circuit.

[0004] Moreover, a decoupling capacitor (or "bypass capacitor") is commonly used to be coupled in parallel to the load.

[0005] This charge switch may or may not be connected to a power supply source.

[0006] When the power supply source is initially turned on, when the charge switch is in the "on" state, and the decoupling capacitor is not charged, a positive inrush current, flowing from the power supply source to the decoupling capacitor, occurs as the capacitor begins to charge. The typical amplitude of this positive inrush current may reach a few amperes.

[0007] Additionally, when the capacitor is charged and when the power supply source is set to zero more or less rapidly, a negative inrush current, flowing from the decoupling capacitor to the power supply source, occurs as the capacitor begins to discharge. The typical amplitude of this negative inrush current may reach hundreds of milliamperes.

[0008] These positive and negative inrush currents are operationally dangerous since they are excessively greater than the nominal current for which the circuit was rated.

[0009] A conventional solution provides for a control of a first positive inrush current. However, such a solution cannot limit a possible negative inrush current and follow a new variation of the voltage of the associated power supply source.

[0010] Another conventional solution provides for the use of a precise current source, for example, based on the forbidden band (or "bandgap") principle. Nonetheless, such a solution increases not only the complexity of the electronic circuit but also its energy consumption.

SUMMARY

[0011] Modes of implementation and embodiments of the invention relate to electronic circuits, notably electronic circuits comprising at least one switch coupled between a power supply source and a load (dubbed hereinafter "charge switch"), more particularly the control of inrush currents liable to flow in the switch when a power supply source is connected to or disconnected from the switch.

[0012] Embodiments of the invention provide a solution having low complexity and low energy consumption, which makes it possible to limit positive and also negative inrush currents liable to flow through a charge switch.

[0013] According to one aspect, a method can be used to control inrush currents due to flow through a switch coupled between an input terminal liable to receive a first voltage and an output terminal coupled to a decoupling capacitor and to a load. The method comprises a comparison between the first voltage and a second voltage which is present at the output terminal, and an activation, as a function of the result of the comparison, of a first or of a second adjustment stage which is configured to respectively limit a positive inrush current flowing between the input terminal and the output terminal or a negative inrush current flowing between the output terminal and the input terminal.

[0014] According to one mode of implementation, if the first voltage is higher than the second voltage, the first adjustment stage is activated in such a way as to limit the positive inrush current. If the second voltage is higher than the first voltage, the second adjustment stage is activated in such a way as to limit the negative inrush current.

[0015] Such a method advantageously makes it possible to determine firstly the direction of an inrush current, namely positive or negative, and then to selectively activate an adjustment stage dedicated to this inrush current in such a way as to limit it properly.

[0016] According to another aspect, an electronic circuit comprises a switch coupled between an input terminal intended to receive a first voltage and an output terminal coupled to a decoupling capacitor and intended to also be coupled to a load. A comparison stage is configured to compare the first voltage and a second voltage which is present at the output terminal. A control circuit is configured to activate, as a function of the result of the comparison between, a first or a second adjustment stage, respectively, configured to limit a positive inrush current or a negative inrush current.

[0017] According to one embodiment, if the first voltage is greater than the second voltage, the control circuit is configured to activate the first adjustment stage in such a way as to limit the positive inrush current, and if the second voltage is greater than the first voltage, the control circuit is configured to activate the second adjustment stage in such a way as to limit the negative inrush current.

[0018] The switch can for example comprise a switching transistor and the first adjustment stage can for example comprise a first detection capacitor configured to transform a positive variation of the second voltage into a variation of a first intermediate current via a first current mirror module, a first reference current module configured to generate a first reference current, and a first voltage adjustment module configured to increase the voltage of the gate of the switching transistor if the first intermediate current is greater than the first reference current.

[0019] The switch can, for example, comprise a switching transistor and the second adjustment stage can, for example, comprise a second detection capacitor configured to transform a negative variation of the second voltage into a variation of a second intermediate current via a second current mirror module, a second reference current module